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A trial on subcutaneous pedicle island flap for eyebrow reconstruction

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ABSTRACT

Introduction: Severe burn is a common problem affecting victim's eyebrows. This study aims to assess the effectiveness, complications and patients' satisfaction in two eyebrow reconstruction surgical methods. Up to now, many reconstruction methods, their specific advantages and complications have been introduced. This study compares a new method (subcutaneous pedicle island flap), which is scarcely discussed, with a standard method (superficial temporal artery island flap).

Method: This is a clinical trial conducted during 2003–2005 at the Al' Zahra' Hospital. Forty patients with eyebrow defect due to burn injuries were selected by convenience sampling. They were allocated to two groups randomly. The control group underwent a surgery for 'superficial temporal artery island flap' and the case group for 'subcutaneous pedicle island flap'. Data were gathered using two questionnaires. The first one included demographic data, patient history and condition of the eyebrows prior to surgery, effectiveness of surgery and complications. The second was a smiley face visual scale for patient's satisfaction. Data analysis was done using SPSS software (version 12; SPSS Inc., Chicago, IL, USA).

Result: Findings showed that in the control group, 80% were female of a mean age of 22 years (SD = 6/30) and in the case group 75% were female, of a mean age of 21/80 years (SD = 8/28). Fisher's exact test showed a significant difference between the type of surgery and hair-growth direction ($p = 0.003$). In addition, Mann–Whitney U test showed a significant difference between the type of surgery and patient satisfaction ($p = 0.002$). Analysis showed that there is no significant difference between the type of surgery and bleeding, congestion, flap necrosis, temporary hair loss in flap and donor-site alopecia ($p > 0.05$). Surgeon's experience shows that surgery time and learning curve in the case group is lower than that in the control group.

Discussion: Subcutaneous pedicle island flap is an appropriate and easy method with good efficacy, lower complication and more reasonable and acceptable patient's satisfaction. Therefore, this method is recommended for burn patients with eyebrow defects.

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1. Introduction

Severe burn, trauma, tumour resection, tattooing, tattooing ablation and resection can all result in eyebrow defects. Eyebrow defects may be unilateral, bilateral, complete or partial. Burn is a common cause of eyebrow defects, and its repair is usually difficult because of its surrounding and adjacent areas [1]. Some problems in this area are scaring, tissue adhesions, etc. Furthermore, ectropion leads to additional problems in eyebrow reconstruction.

Eyebrows are an important factor of beauty. Regarding the protective role of eyebrow and its effect on beauty, its repair can play a significant role in patient's appearance, and therefore in his or her body image. The commonly recommended treatments in this area are (1) grafting from scalp or another eyebrow (this method has been in use for many years) and (2) superficial temporal artery island flap (posterior branch) [2,3]. The second method has some problems such as extensive dissection, donor-site alopecia and unnatural hair-growth direction. It is a complex and time-consuming procedure. In addition, surgeons need significant time to gain expertise; so it has a long learning curve.

This study aimed to assess the effectiveness, complications and patient satisfaction with a new, special flap (subcutaneous pedicle island flap) in comparison with the classic superficial temporal artery island flap.

2. Method

This clinical trial was conducted during 2003–2005 in the Al' Zahra's Hospital. Forty patients with eyebrow defects owing to burn injury were selected by convenience sampling. Entry criteria were burn-related defects, intact frontal muscle fascia, same level of scar (level of scar was assessed based on Vancouver scar scale) [4] and having no history of alopecia. Subjects were allocated randomly to two groups.

Data were gathered using two questionnaires by a surgeon who was blinded to the study procedure. The first questionnaire comprised four parts: (A) patient's characters (i.e., age and gender), (B) condition of the eyebrows prior to surgery (i.e., severity of defect, burn on upper eyelid and ectropion, burn on the forehead, previous burning and scar), (C) a history of alopecia and reconstructive surgery for eyebrow defect and (D) surgery-related complications. We considered early complications (e.g., bleeding, congestion and necrosis) and late complications (e.g., temporary or permanent hair loss, donor-site alopecia and hair-growth direction). The second questionnaire was a smiley face visual scale for assessing patient's satisfaction, including five options (very happy, happy, neutral, sad and very sad).

The control group underwent surgery for superficial temporal artery island flap, the case group for subcutaneous pedicle island flap. Both the procedures were carried out by the same surgeon.

This method included a hair-bearing skin island from the frontal area or anterior temporal area with subcutaneous pedicle from the frontal muscle fascia. Supra-trochlear or supra-orbital arteries on the medial side of pedicle can increase its blood flow. However, this flap can survive with a lateral fascia pedicle even without such supply. We preferred to take an island from the hair-bearing scalp skin. The island was designed at least 2–3 cm posterior to the temporo-frontal hairline to avoid further male-type alopecia in the reconstructed eyebrow (Fig. 1a). The posterior incision was made deep to the upper layer of the periosteum. The anterior edge of incision extended subcutaneously to the upper level of frontal muscle fascia (Fig. 1b). Dissection was continued from the posterior to the anterior incision at the supra-periosetal level, but dissection at the anterior incision was made subcutaneously to maintain a pedicle. Dissection was continued subcutaneously up to one-third of the forehead height. It was done specially to protect the frontal branch of the facial nerve during dissection. A subcutaneous tunnel was made from the donor site to the new eyebrow site to transfer the flap from this tunnel subcutaneously (Fig. 1c). The donor site was treated with an advancement flap.

In bilateral eyebrow loss, new eyebrow site is designed based on the concept of symmetry, as described by Leonardo [5]. However, in unilateral eyebrow loss, the contralateral eyebrow is used as a model [6].

Patient assessment was done after randomisation and prior to the scheduled surgery, during surgery, and 72 h, 2, 6 and 12 months after surgery. Patient's satisfaction was assessed after 12 months. Data analysis was done using SPSS software (version 12; SPSS Inc., Chicago, IL, USA) with descriptive and inferential statistic.

3. Result

Twenty patients each in the control group and in the case group were assessed. All of them had unilateral defect in an eyebrow; therefore, 20 surgical procedures in each group were done. Eyebrow defects in all subjects were due to burning. The lag time between burn and surgery were reported more than 2 years.

It was found that, in the control group, 80% were female of a mean age of 22 years (standard deviation (SD) = 6/30), and, in the case group, 75% were female of a mean age of 21/80 years (SD = 8/28) (Table 1). Seventy percent of the case group and 75% of the control group had ectropion and upper eyelid burning. Fifty-five percent in the case group and 70% in control group had burn injury of the forehead as well. Seventy percent in the control group and 95% in the case group reported one to two previous surgeries for their eyebrow defect.

The Fisher's exact test showed significant difference between the type of surgery and hair-growth direction ($p = 0.003$). As with a subcutaneous pedicle island flap, we used a flap from a less-hair-bearing area in frontal area (pretrocheal), we easily achieved a normal hair-growth direction, but with a superficial temporal artery island flap, we had less successful results.

Figs. 1a,b and 2 show patients who underwent surgery for subcutaneous pedicle island flap before and after surgery. Fig. 3 shows a patient who underwent surgery for superficial temporal artery island flap.

Another operation was required for repairing the interruption in the eyebrow. Usually, the classic method involves two or more stages of reconstruction. Of course, this case had a

Fig. 1 – Technique steps: (a) using marking stick; (b) posterior incision from skin to upper periostal layer and anterior incision from skin to upper fascia; (c) island flap was transfered from scalp to new eyebrow site through subcutanous tunel; (d) skin island was transfered completely; (e) before surgery; and (f and g) after surgery.

Fig. 2 – patient's appearance (case group): (a) before surgery; (b) 6 months after surgery; and (c) 1 year after surgery. Donor scar is not noticable.

partial defect, and this interruption was between the primary and the reconstructed eyebrows.

The Fisher's exact test showed that there was no significant difference between the type of surgery and bleeding, congestion, flap necrosis, temporary hair loss in flap and donor-site alopecia ($p > 0.05$). Bleeding and oozing, which usually occurred during 48 h after surgery and sealed spontaneously, were not different in the two groups. Surgeon's experience showed that surgery time and learning curve in the case group was lower than in the control group. Four patients in the case group and nine in the control group had flap congestion that healed gradually. Four patients in the control group experienced temporary flap hair loss, which grew again after 6 months.

In addition, Mann–Whiney *U* test showed significant difference between the type of surgery and patient satisfaction ($p = 0.002$) (Fig. 4).

4. Discussion

Eyebrows express a person's thoughts and emotions without an uttered word [7,8]. Considering the role of eyebrows in beauty and eye protection, it is necessary to be careful in its reconstruction to achieve a much normal appearance.

There are several methods for eyebrow reconstruction, including (1) camouflage and use of special eyebrow pencils, (2) composite hair graft, including micro-grafts, strip grafts and punch graft, (3) superficial temporal artery graft (posterior branch), (4) interpolation scalp flap (in two stage) [2,7].

All of the above-mentioned techniques have their specific advantages and complications. For instance, some surgeons suggested flaps for men and grafts for women due to its density and thickness [7]. However, grafts do not have adequate density. Some surgeons reported some problems in using micro-graft or composite grafts in repair

Table 1 – represent distribution in regard with technique used for reconstruction of eyebrows.

Technique	Male	Female	Age (years)
Superficial temporal artery island flap	20%	80%	22 ± 6/30
Subcutaneous pedicle island flap	25%	75%	21/80 ± 8/28

Fig. 3 – patient's appearance (control group): (a) before surgery and (b) 6 months after surgery.

of a burned–scarred area [8]. A scar is a significant issue in burned area.

Superficial temporal artery island flap with posterior branch (a classic method) is a complex method, requiring extensive dissection. Hair-growth direction is not satisfying and ideal in this method. Sometimes surgeons face problems due to the short arterial pedicle in which they need arterial graft. This additional procedure makes it more complex [9].

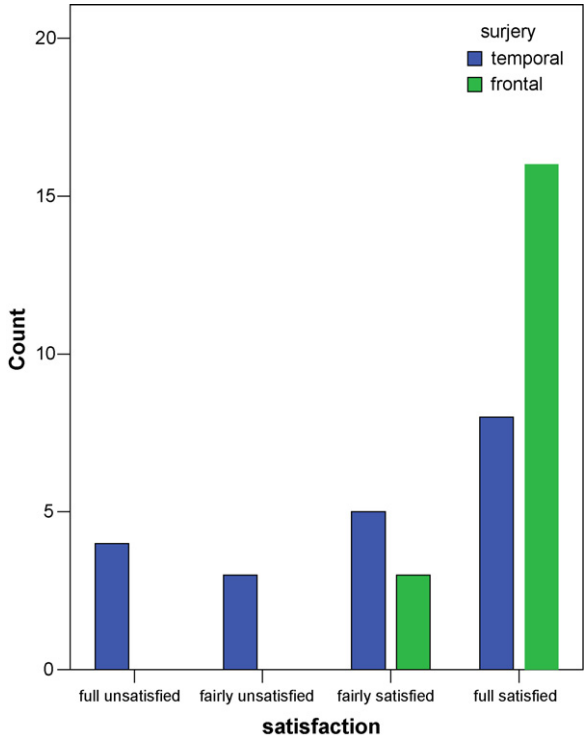

Fig. 4 – Patients' satisfaction from surgery (green: subcutaneous island flap and blue: superficial temporal artery island flap).

However, there is no any reported study about subcutaneous pedicle island flap for eyebrow reconstruction, but Rov Argamas used an island flap from the forehead skin for nasal reconstruction [10].

Subcutaneous pedicle island flap closer to the eyebrows have a rich blood supply. Considering this significant character, it is transferable and some surgeons used it for repair of partial defects and small- to medium-sized eyebrows defects successfully. Other surgeons reported its benefits in nose, cheeks and forehead reconstruction [11,12]. Another study mentioned using the flap from eyebrows area for partial defects of eyebrow. Frontal, orbicular muscles in the forehead area have a rich blood supply [12]. They are supplied with perforator and horizontal plexus of vessels that originate from the supra-orbital and supra-trochlear arteries and are connected with the superficial temporal artery (Fig. 5) [13,14]. On the other hand, they are supported with supra-orbital and supra-trochlear arteries in the frontal area and the scalp [12].

Surgeons use scalp flaps less frequently, because of the patient appearance between two stages of surgery. It is a traditional method for those patients who cannot benefit from any other methods. Z-plasty and advancement are appropriate methods for partially injured eyebrows. Other studies referred to the forehead flaps with an inferior pedicle as a subcutaneous pedicle flap [3,16].

In this method, it is possible to select a donor from hair-growth line in the frontal and temporal area. Hair-growth direction will be much better. In addition to the above-mentioned advantages, this study showed some other advantages. We could obtain flap from an area, from which it was possible to take an island with good hair density, for achieving reasonable aesthetic appearance. In this method, it

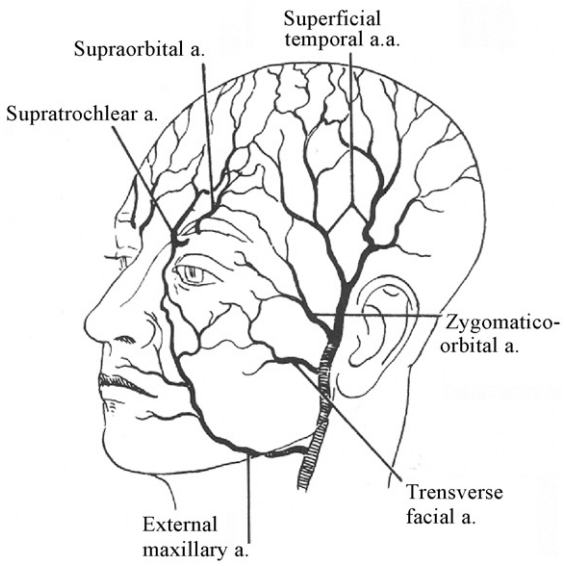

Fig. 5 – Blood supply of the forehead (from Ref. [15]).

is necessary to take a flap not only with adequate hair but also with an artery.

This method seems to have shorter duration of surgery and a shorter learning curve. The duration of surgery was 60 ± 5 min in the case group and 80 ± 20 min in the control group.

This method is not suitable in case of severely burned forehead and a damaged muscle fascia. Patients having donor-site alopecia are excluded for this method. Flap alopecia may occur in patients who have a family history of male-type alopecia. In this situation, it is possible to obtain a flap from the more posterior area (i.e., more than 2–3 cm posterior to the temporo-frontal hairline). Hair in flap area grows rapidly than the normal eyebrow, so it must be trimmed every week.

With regard to the finding of this study, we recommend this method as an alternative and an ideal method for eyebrows reconstruction as it is easy Using this method, we can see better results in the long term with regard to hair-growth direction and patient satisfaction.

Conflict of interest

The authors have no conflict of interest to report.

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